though occasionally successful for a moment, is the most wasteful and destructive of all methods of sharpening the teeth.

What we have at some length discussed is the most prominent feature of the present work, but by no means its only distinctive one. No writer, who has any claim upon his readers at all, can treat even the most hackneyed subject without giving a new and useful turn to many a long-known truth. Many of Prof. Clifford's proofs are exceedingly neat, and several useful novelties (*e.g.* Three-bar Motion) are introduced. We have to complain, however, of a great deal of unnecessary new and very strange nomenclature:—for a large part of which the author is not responsible, his error (for such we cannot help considering it) consisting in giving this stuff a place of honour in his book. One does not require to be very violently conservative to feel dismayed at an apparently endless array of such new-fangled terms as Pedals, Rotors, Cylindroids, Centrodes, Kites, Whirls, and Squirts! Yet these are but a few gleaned at random from the book. Something, it seems, *must* be hard in a text-book—simplify the Mathematic, and the Anglic (*i.e.* the English) immediately becomes perplexing. P. G. TAIT

PHYSICS OF VOLCANOES

Beitrag zur Fysik der Eruptionen und der Eruptiv-Gesteine. Von Dr. Ed. Reyer, Docent an der Universität in Wien. (Vienna: Alfred Hölder, 1877.)

DR. Reyer, of Vienna, has already made his mark in geological literature by the admirable work entitled "Die Euganeen: Bau und Geschichte eines Vulcans," in which he has given a very clear and instructive interpretation of the phenomena presented by that grand tertiary volcano of Northern Italy, of which the internal structure has been so well displayed to the geologist through the agency of denuding forces. Those who are acquainted with the merits of the first published work of Dr. Reyer will eagerly take up the volume which has now made its appearance, the title of which stands at the head of the present notice; nor will their anticipations that a difficult question will meet with masterly and original treatment at the hands of its author be disappointed.

A starting-point for a series of discussions of the phenomena of volcanic action and the causes to which these are due is found by Dr. Reyer in the demonstrated capacity of various substances in a state of igneous fusion for absorbing certain gases. If the suggestion that in this peculiar property of bodies in a state of fluidity under the action of heat we find a key to many of the most remarkable phenomena of volcanic eruptions be not altogether new, it must at least be admitted that it has never before received such ample discussion and illustration as it now undergoes in the hands of Dr. Reyer, and even still less has hitherto been done in applying the explanation in question to these numerous minor and concomitant phenomena which precede, accompany, and follow volcanic outbursts.

In the first part of the work before us, the author, after citing the interesting observations of Gay Lussac, Fournet, Thenard, Réaumur, and other chemists, in proof of the property of absorption as displayed by substances in a state of igneous fusion, goes on to show that many of the striking appearances exhibited during volcanic eruptions clearly point to the conclusion that a highly-heated magma within the earth's crust has, through infiltration, become charged with liquid and gaseous materials. He then proceeds in the second part of the volume to show how many of the phenomena of volcanoes—such as the succession of events in the history of their formation and in that of each individual eruption, the peculiarities of the internal structure of volcanoes and of the masses of lava extruded from their vents, and the nature of the gaseous exhalations which accompany the outbursts during their several stages—receive a simple explanation from this remarkable property exhibited by substances in a state of fusion.

Apart, however, from the value of its more speculative portions, Dr. Reyer's work will be welcomed by geologists as bringing together in a connected form all the most important of the recent observations which have been made upon the nature and products of volcanic activity. It is in this respect that the third part of the work before us, that which deals with the peculiarities of volcanic rocks, appears to us to be especially worthy of attention. The author not only admits that the principle which has been so long followed by German petrographers, of basing the classification of igneous rocks on their geological age, is altogether untenable, but he goes farther and strongly denounces the mischievous tendencies of this method in obscuring some of the most striking inferences to be derived from the exact study of such rocks. Strongly insisting on the fact that portions of the same magma may, under different physical conditions, assume a granitic, a porphyritic, or a vitreous structure, Dr. Reyer shows clearly how the various igneous intrusions found associated with sedimentary deposits were in all probability originally connected with centres of volcanic activity; and he also shows the grounds for the inference that masses of granitic structure are being formed at the present day by the slow consolidation under pressure of portions of the magma below the existing volcanic vents.

Of the urgent necessity for reforms in our petrographical nomenclature, the author of this work, holding the views he does, clearly perceives the necessity; and his suggestions upon the subject deserve, as they doubtless will receive, the careful attention of geologists. Some of the interesting relations between the structure and composition of rocks are, we may remark in passing, very well illustrated by the series of ingenious diagrams which accompany this volume. J. W. J.

OUR BOOK SHELF

Travels in the Footsteps of Bruce in Algeria and Tunis; Illustrated by Facsimiles of his Original Drawings. By Lieut.-Col. R. L. Playfair, H.B.M. Consul-General in Algeria. (London: C. Kegan Paul and Co., 1877.)

THE northern regions of Africa that border on the Mediterranean Sea would form a deeply interesting study for the historian. Perhaps no other portion of the world's surface has passed through more marked phases of civilisation, yet all of these have passed away and left but small trace behind them. Placed between a wondrously teeming offshoot of the Broad Atlantic

and a markedly sterile desert, this strip of territory seemingly wanting in none of Nature's riches save flowing rivers, has been conquered successively by the Romans, the Vandals, the Byzantines, the Greeks, and the Arabs. All these several possessors came and conquered and settled on these lands; but the first four civilisations died away, and the last is disappearing, in at least the large central portion of this district known as Algeria, and now under French rule. Who can tell whether this new phase will have any more vitality than the rest?—for the native tribes seem to be as unreclaimable as their own Sahara.

The many architectural ruins scattered over this district still attest the greatness of her conquerors, and the visitor to any of the provinces of Algeria, more especially to Algiers, will be astonished at the size and grandeur of these remains. In 1765 the traveller Bruce, as he tells us in an autobiography, was told by my Lord Halifax, "that the way to rise in the king's favour was by enterprise and discovery; that all Africa, though just at our door, was yet unexplored; that every page of Dr. Shaw, a writer of undoubted merit, spoke of some magnificent ruins which he had seen in the kingdoms of Tunis and Algiers, and that now was the age to recover these remains and add them to the king's collection." With this suggestion Bruce was offered the post of consul at Algiers, with a good salary. Bruce at once put aside for the moment all thoughts of the fountains of the Nile, "as involving an enterprise above the powers of an untried ordinary man," and setting out for Italy, he passed through France, and was carried in H.B.M. frigate *Montreal* from Naples to Algiers. The story of Bruce's life is yet to be written; probably no traveller has ever had to contend against a greater amount of ill-deserved obloquy. His account of his travels, we know, was received with the greatest incredulity, and yet there are very few of his statements that have not, since he published them, been abundantly confirmed. It would seem but an act of justice that we should, in the light of modern discovery, have a new edition of Bruce's Travels thoroughly well annotated, and we can think of no one so well qualified for this task as the author of this volume, which gives us an account of how Col. Playfair came to travel in the footsteps of this great father of African travel.

Bruce, we have seen, was British Consul-General at Algiers in 1765, and he received this appointment to enable him to examine and describe the many fine ruins said so truly by Dr. Shaw to be scattered over Tunis and Algeria. An account of these travels, with detailed descriptions and drawings of these ruins, was prepared by Bruce, with the intention of publishing them; but it is probable that the manner in which the simple narrative of his travels was received by the public had the effect of making him abandon this idea.

We must refer the reader to this volume for information as to how Col. Playfair, who now occupies Bruce's place as H.M. Consul-General at Algiers, discovered Bruce's manuscripts and drawings in the library of Lord Thurlow, whose wife is the great-great-granddaughter of the traveller as well as heiress of Kinnaird. As a result of this discovery, Col. Playfair determined to follow Bruce's footsteps in Tunis and Algeria, to visit every ruin which he had illustrated, and so to plan his route as to include all that was most picturesque and instructive in a country that is even yet hardly at all known to the modern traveller; and well he does all this in the sumptuous quarto volume before us.

This volume will form a lasting monument to the memory of Bruce, and some five-and-twenty of the large quarto illustrations, being facsimiles from Bruce's drawings, will serve to show how accurate as an architectural draughtsman he was, and how independent he might—had it not been for the fashion of the times—have been of the "adornments" of his Italian artist.

E. P. WRIGHT

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

On the Availability of Normal-Temperature Heat-Energy

1. I WAS interested to see the letter of Prof. A. S. Herschel, in NATURE, vol. xviii. p. 39, referring to my papers on the subject of the derivation of work from normal-temperature heat (NATURE, vol. xvii. p. 31, and vol. xvii. p. 20). There is one qualification (not affecting the reasoning in my papers) I should like to make here, viz., the case there dealt with does not appear necessarily to be out of harmony with what is termed the "second law of thermodynamics," though it may be questioned whether it quite harmonises with certain modes of stating the law. As the *facts* are of course the most important, it may perhaps be well just briefly to recapitulate here under what conditions normal-temperature heat can be converted into work, as affecting the problem dealt with.

2. Firstly, we observe that the diffusion of matter (gases) enables us to derive work solely at the expense of normal-temperature heat (*i.e.*, without an artificially-produced fall of temperature or a source and a refrigerator); and through this process a mass of gas may (by unchanged total volume) acquire a capacity for work without the performance of work. I say that the work is derived *solely* at the expense of normal temperature heat, because, although the mixing or diffusion is a necessary accident to the derivation of the work, it is in no way the *source* of the work, or the heat lost is the exact mechanical equivalent of the work derived, and the diffusion has nothing to do with furnishing the work. Still the system, after diffusion, is evidently not restored to its original state in all respects, *except the transference of heat*, although the passage of the system from its original to its final state did not furnish any of the work. To violate the second law of thermodynamics, the system would require to be restored to its original state, and if a method could be discovered for doing this, clearly no work would be theoretically required merely to effect this result (since the total volume of the gases is unchanged by the mixing).

3. It would seem scarcely to be brought into sufficient prominence in connection with the statement of the "second law of thermodynamics," how far it is possible (without a source or refrigerator) to convert normal-temperature heat into work, which is really the practical point; for there are many cases where it is of no consequence to us whether the matter from which the heat is derived is mixed or not. The great point is to derive the heat or convert it into useful mechanical energy. This is what it was my main object to treat of in the two papers referred to.

4. No doubt in nature normal-temperature heat is thus largely utilised or converted into work. For in the functions of plants and animals, two gases of different molecular weights, oxygen and carbonic acid, are largely concerned, and animal and vegetable structures are notably *porous*, so that no doubt normal-temperature heat may be converted into work through diffusion in this way—*i.e.*, by the different rates of diffusion of the two gases across the porous tissues. Indeed this principle might conceivably have more to do with animal and vegetable functions than is imagined. There are also mixtures of gases used in industrial operations, such as for explosion in gas-engines, &c. No doubt in such cases before exploding the gases, normal-temperature heat might be converted into work through diffusion (by means of a porous diaphragm connected with suitable machinery, in the manner roughly sketched), and the utility of the process would depend simply on the quantity of gas at disposal.

5. In regard to the means afforded by a porous diaphragm for (as it were) manipulating molecules and sifting them according to their velocities; no doubt this (as Prof. A. S. Herschel remarks) somewhat resembles the functions performed by the ideal being or "sprite" described by Prof. Maxwell in his "Theory of Heat," but it does not quite attain that result, for the diaphragm can only effect an unequal distribution of energy *combined with* an unequal distribution of *matter*, so that the